UNITED STATES DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

Summary Review of Monthly Reports*
for
SOIL CONSERVATION SERVICE RESEARCH**
JUNE 1948

EROSION CONTROL PRACTICES DIVISION

Residual Effects of Organic Treatments - O. R. Neal, New Brunswick, New Jersey.-"In conducting a study of the effect of crop rotation on runoff, it has been possible, due to the experimental design, to collect data simultaneously on the residual effect of earlier treatments on the plots. The treatments included annual manure applications, annual winter cover crop of rye, a combination of the manure and cover, and an untreated check. These treatments were applied over a 4-year period. During that time the manure and the cover crop treatment each reduced soil and water losses very markedly in comparison with the check. The combined treatment brought still further reductions in losses. Beginning in 1942, the treatments were stopped and the plots utilized for the present rotation study. Data on residual effects of the earlier treatments on soil and water losses and on crop yields have been summarized for the 6-year period since 1942.

"During the first three years following cessation of the treatments, tomato and sweet corn yields were higher on all the treatments than on the check areas. The increase on the cover crop and on the cover-plus-manure treatments was significant while the manure treatment barely failed to reach significance at 5%. During the second three year period no significant differences in yield of either crop on any of the treatments occurred.

"Since only half of the plots are equipped with measuring equipment it is possible only to compare runoff from the check treatment with manure, and from the cover crop treatment with cover-plus-manure. In the former case, runoff and soil loss were consistently lower from the manure treatment than from the check. In the latter comparison the cover-plus-manure treatment was equally superior to the cover crop treatment. These reductions in runoff and soil loss continued throughout the 6-year period with only slight abatement.

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** All research work of the Soil Conservation Service is in cooperation with the various State Experiment Stations.

"The outcome of such a study would doubtless vary with both soil conditions and with crop production practices. Under local conditions, earlier organic matter treatments influenced crop yields for three years following treatment. No significant yield differences occurred during the ensuing three years. The same treatments reduced runoff and soil losses consistently throughout the entire period. Residual effects of the organic treatments were considerably greater from the conservation standpoint than from that of crop yield."

Effects of Soil Treatments on Yield of Alfalfa and Alfalfa-Brome Mixture - D. D. Smith, Columbia, Missouri.-"Yields of alfalfa-bromegrass from the deep limed, fertilized and shattered plots harvested in May were as follows:

	Alfalfa	Alfalfa and Brome
Check	0.98	1.03
Shatter only	.97	1.27
Shatter plus C-N-P-K	1.14	1.40
Shatter plus rock phosphate	.98	1.67
C-N-P-K on plow sole	1.13	1.80

This was the first cutting after seeding in September 1947."

Studies of Treatments for Eroded Blackland - J. R. Johnston, Temple, Texas.-"It has been estimated that 15 to 20 percent of the Texas Blackland has lost the original topsoil by erosion. This land cannot be used to grow row crops profitably; it should be in good grass cover to prevent further deterioration and for grazing purposes. Efforts at establishing grass on this severely eroded and depleted land has not been too successful. It has been thought that nitrogen fertilization of these eroded lands could aid in the establishment of grass. Another contention has been that these lands will have to be recharged with organic matter, nitrogen, and phosphorous before grasses can be established. This study was designed to give data on these ideas.

"The first phase of investigational work on how to improve badly eroded Blackland soils so that grasses can be establsihed has been completed. The data obtained from a green house study on plant growth from various layers of Austin clay soil with and without fertilization are given in Table 1. These data show that the topsoil, with or without nitrogen fertilization, produces good grain and vegetative growth of oats. The lower layers made poor growth regardless of nitrogen fertilization. Sweetclover growth in the topsoil was good without phosphate, fair in the 6"-12" layer, and very low in the subsoil layers. Phosphate fertilization gave slightly increased growth in the topsoil and tremendously increased growth in the subsoil layers.

Table 1. Sweetclover and oats response* to phosphate and nitrogen fertilization of Austin clay profile layers.

Profile	Effect of nitrogen** on oats growth						Effect of phosphate* on sw. cl. growth		
	No fert.		25# N/A		50# N/A				
Depth	grain	straw	grain	straw	grain	straw	No fert.	25#P_2O_5/A	50#P_2O_5/A
Inches	gms/pot	gms/pot	gms/pot	gms/pot	gms/pot	gms/pot	gms/pot	gms/pot	gms/pot
0-6	7.29	8.88	7.81	10.45	7.86	9.97	12.93	15.76	15.33
6-12	2.35	4.92	3.60	4.47	2.29	4.03	4.20	12.17	12.07
12-18	.86	1.87	.19	1.32	.09	.87	.11	8.88	9.13
18-24	.59	1.39	.16	1.23	.23	1.07	.14	6.52	8.98
24-30	.01	1.02	.09	1.10	.28	1.04	.33	7.99	7.61
30-36	.23	.38	.22	.92	.03	.75	.05	5.17	6.42

* All data reported are averages of 3 replicates. Sweetclover and oat straw on over-dry basis, oat grain on airdry basis.

"Study of these data bring out the following interesting points:

1. The productivity of the subsoil, insofar as oats and sweetclover are concerned is very poor as compared with the topsoil.
2. Nitrogen fertilization alone does not increase growth of grass in subsoil.
3. Phosphate fertilization increases greatly the growth of sweetclover in subsoil.
4. The growth of sweetclover in the subsoil with phosphate fertilization was not as great as the growth in the topsoil. This shows that some other factor limits maximum growth of sweetclover in subsoil, possibly deficiencies of one or more nutrient elements or poor air and water relationships resulting from low organic matter content.
5. These data lend support to the idea of grass establishment on the eroded land in this area by first growing an abundance or organic matter and nitrogen by mineral fertilization of sweetclover.

"This study is being continued to give information on how effective one or more crops of sweetclover is in the establishment of grass on the eroded lands of this area.

"Phosphate fertilization of the soils in this area for sweetclover growth has come to be an accepted and proved practice. The possibility of getting better sweetclover growth by application of other deficient elements arises. An exploratory survey for other element deficiencies has been completed under greenhouse conditions with sweetclover. The 0"-6" layer of Austin clay (same as the 0"-6" layer used in the study reported above) was used in this study. All of the soil was fertilized with 50 pounds P_2O_5 per acre; ten other elements were used separately in addition to the phosphorus. The data obtained from this experiment are reported in Table 2. Study of these data show that very little response was obtained by fertilization with other elements, which indicates that the topsoil of Austin clay is adequately supplied with plant food nutrients other than phosphorus.

"This minor element work is to be continued on the lower layers of this soil so information can be obtained on the nutrient status of the land in the area which has lost the topsoil by erosion."

Table 2.-- Effect of minor elements on sweetclover growth in Austin clay topsoil.

Minor element	Source and rate of fertilization		Dry matter production
	compound	lbs/A	gms/pot
None	-	-	8.6
Boron	$Na_2B_4O_7$	50	10.1
Cobolt	$CoCl_2 \cdot 6H_2O$	10	9.8
Copper	$CuSO_4$	10	10.7
Iron	$Fe_2(SO_4)_3$	100	11.3
Magnesium	$MgCl_2$	100	11.7
Maganese	$MnSO_4$	100	11.2
Potassium	K_2SO_4	100	11.0
Sodium	Na_2SO_4	100	11.3
Sulfur	S	100	11.4
Zinc	$ZnSO_4$	100	10.3

<u>The Length of Time it Takes for Conservation Programs to Pay out from the Increased Profits Derived from them</u> - E. L. Sauer, Urbana, Illinois.-"A summarization of available data shows that in the Madison-St. Clair counties area the conservation program on the high conservation farms would pay out in two and one-half years at the 1945 rate of increased income due to conservation. In McLean County it would require 5.8 years to pay out the total costs of conservation on the high-score farms at the 1945 rate of increased income. In the Stephenson, JoDaviess, and Winnebago counties area, using the six-year average of $4.22 increased income from conservation farming, it will take 3.8 years to pay the total cost of conservation. In the northeastern Illinois slowly permeable soils area, we have data for only the past three years. These data, however, show increased earnings of $9.96 per acre on the high conservation farms. Based on the approximate costs of conservation in this area, it would take four years of increased income to pay the total costs of a conservation program.

"The increased incomes from conservation are considerably higher at the present time, due to the high prices of farm products. It is quite likely that the dollar increases will decrease somewhat as farm prices decrease. However, the costs of establishing a conservation program are not likely to decrease in the same proportion as the price of farm products. Prices of such things as limestone, phosphate, and other fertilizers have not gone up as much as grain and livestock prices and are not likely to decline as much. Nevertheless, any way you figure, it looks to me like it is good business to incur necessary expenses to establish a soil conservation program as rapidly as possible."

<u>More Attention Should be Given to What Happens to and in Soils During the Winter Months</u> - C. S. Slater, College Park, Maryland.-"Samples that were collected last spring by Henry Hopp and myself have been analyzed. Soils that had had fall and winter protection were far more water stable (i.e., were in better tilth) than those that had been bare during the winter.

"More attention should be given to what happens to and in soils during the winter months. Lack of cover allows freezing and thawing to occur repeatedly; resulting, in moist soils, in a marked breakdown in aggregate stability. From our results to date it is doubtful if frost is ever 'good' for soils. The bursting of bonds within aggregates causes frosted soils to slump readily, and any improvement in granulation that may have been noted in the spring and attributable to frost action appears to be lost in the growing season by slumping as soon as heavy rains begin.

"Earthworms are killed out on unprotected soils. Evidence is mounting that their activities improve surface drainage, allow free water to by-pass the surface soil during the winter months without undue leaching, promote aeration, and improve crop growth. If earthworms are winter-killed, it may be presumed that the nitrogen in their bodies commonly is lost by leaching. On protected soil mature earthworms tend to die out in midsummer when the readily available nitrogen of their bodies can be used to promote crop growth."

Earthworms Increase Soil Productivity in Controlled Experiment - Two years ago we started an experiment to test the effect of earthworms on soil productivity. Twenty barrels were placed outdoors and filled with an extremely impoverished clay subsoil. At the start, the soil in all barrels was manured, fertilized, limed, cultivated and seeded to a grass-legume mixture. Later, variations in fertilization and winter surface protection were introduced into the experiment. The barrels were paired, one of each pair was inoculated with living earthworms. Where the sod growth was left in the fall, so that the soil surface had ample winter protection, dry-weight yields of duplicate barrels averaged as follows this spring:

Topdressed with Fertilizer	Inoculated with Living Worms	Not Inoculated with Living Worms	Effect of Inoculation
	T/A	T/A	T/A
No	1.44	.32	1.12
Yes	1.96	.60	1.36
Effect of Top-dressing	.52	.28	

"The inoculated barrels bore a luxuriant growth of clover, while the uninoculated barrels bore a weak stand of grass, weeds, and lespedeza. This extraordinary effect of earthworm activity was attributed to the improvement in soil structure which they brought about in this clay soil."

Wind Erosion in Relation to Land Classes and Tillage Methods - H. G. Porterfield, Brownfield, Texas.-"With very deficient moisture conditions in May and June, planting conditions have been poor. Several severe sand storms did great damage to planted crop and the estimate for Terry County was approximately 50 per cent destroyed. Five sand storms beginning June 19, for five succeeding days, destroyed approximately one-half of the plot work on the station. There were some interesting comparisons on degree of damage on land classes and type of tillage methods.

Deep broke land with clay on the surface was free of wind erosion damage on both Class III and Class IV land. Listing was effective on Class III land but was completely destroyed on Class IV land. Subsurface tillage work with a Hoeme held Class III land but there was moderate wind erosion damage on stubble mulch plots with sorghum cover on Class IV land. The Noble blade was not successful for subsurface tillage on sorghum cover. The spinning of the tractor wheels buried the stalks into the soil which caused the blade to drag. Also, on wheat stubble test plots, Johnson grass gave the same trouble and it could not be used. A 4-row tractor will not pull in this sandy soil as large a Noble blade as recommended on tighter soils for this size tractor. The Hoeme cultivator equipped with knife attachments did a fairly good subsurface tillage job."

Runoff in Relation to Land Use Treatments - Harley A. Daniel, Guthrie, Oklahoma.-"Precipitation at the Guthrie station for the month was 7.00 inches. Results obtained showed that soil conservation practices conserved water during these storms. The rains began the afternoon of June 20, and by the evening of the 21st we had received 1.92 inches. During the evening and night of the 22nd, we had another rain of 5.08 inches which fell on wet soil. The following data shows the effect of erosion and soil conserving measures on the conservation of water during this rain.

SOIL CONSERVING TREATMENTS On Land Slope of 7.7%	PRECIPITATION 5.08 INCHES	
	Inches of Water Lost in Runoff	Percent Stored in Soil
Eroded Soil (10" removed)	3.90	23.2
Bare (hard fallow) Land	2.93	42.3
Cotton Land	2.22	56.3
Sweet clover Mulch*	0.42	91.8
Bermuda Grass Sod	0.06	98.8

* A second-year crop of 4500 pounds per acre of sweet clover and stubble had just been partially worked into the surface soil.

"Although this big rain made a total of seven inches during the three days, grass and mulch on deep soil greatly reduced the amount of runoff water. This water was stored in the soil for plant use and did not contribute to the flood waters of the local streams."

Effect of Contouring on Soil and Water Losses on Corn Land - C. A. Van Doren, Urbana, Illinois.-"Contoured plots in corn and soybeans at Urbana lost considerably less soil than non-contoured plots during late June. Losses from five storms causing runoff are shown in the following table. On the corn plots the ratio of losses on contoured compared to non-contoured was (1711 ÷ 4591) 0.37, as compared with 0.61 for the period 1941-1947. Comparable ratio of losses from soybean plots was (1066 + 3901) 0.27, as compared to 0.28 for the period 1944-1947. The effectiveness of contouring was surprising for these storms. Both crops were planted with furrow openers, however, they had been cultivated only once and very little ridging and storage capacity was developed.

"Runoff from all storms was less on the contoured plots.

Soil and Water Losses in June 1948 - Contour Farming Study

Date	Rainfall	Corn Contour	Corn Non-Contour	Soybeans Contour	Soybeans Non-Contour
			Soil Losses		
June 21-22	0.99	-	514 lbs/A	-	327 lbs/A
June 23	0.87	336 lbs/A	1122	98 lbs/A	907
June 25	0.52	50	247	-	170
June 26	1.04	556	1160	326	874
June 28	0.82	769	1548	642	1623
		1711	4591	1066	3901
			Runoff Losses		
June 21-22	0.99	-	0.15 in.	-	0.11 in.
June 23	0.87	0.19 in.	0.38	0.07 in.	0.25
June 25	0.52	0.05	0.11	-	0.09
June 26	1.04	0.44	0.52	0.33	0.38
June 28	0.82	0.45	0.53	0.43	0.47
		1.13	1.70	0.83	1.30

Mulch Farming in Relation to Soil and Water Loss and Oat Yield - O. W. Beale, Clemson, S. C.-"The effects of different tillage methods of land preparation on runoff, erosion and yields where oats followed Kobe lespedeza, are indicated by marked differences between treatments. The land was prepared by three methods: plowing with a disk tiller, followed by a disk harrow; disking with a heavy disk harrow and plowing with the Graham-Hoeme ripping implement. Table 1 shows the runoff and soil loss from the different treatments. Much less runoff and erosion resulted from the treatment in which the Graham-Hoeme tool was used than in the plowing and disking methods.

"The indicated yields of oats from the three treatments are given in table 2. The oats were planted later in the fall than usual on account of the extended rainy season. The differences between the ripping method and the plowed and disked methods are significant at the 5% level.

Table 1.--Influence of tillage methods on runoff and erosion from oat plots during the growing season.

Date	Total Rainfall	Land plowed with a disk tiller followed with disk harrow		Land disked thoroughly with heavy disk harrow		Land prepared by plowing twice with Graham-Hoeme implement	
		Runoff	Soil Loss	Runoff	Soil Loss	Runoff	Soil Loss
	Inches	%	lbs./A.	%	lbs/A.	%	Lbs./A.
Dec.	2.72	none	none	none	none	none	none
Jan.	3.10	none	none	none	none	none	none
Feb.	5.04	5.02	83	6.81	110	1.83	10
Mar.	8.66	29.45	2790	23.14	1627	7.33	573
April	1.07	21.87	226	19.63	169	10.19	71
May	4.82	18.55	178	10.37	75	2.93	18
Total	25.41	15.47*	3277	12.03*	1981	3.84*	672

* Percentage of total rainfall.

Table 2.--Yields of oats from runoff plots where land was prepared by different methods.

Soil plowed with a disk tiller, followed with disk harrow		Soil disked thoroughly with heavy disk harrow		Land prepared by plowing twice with Graham-Hoeme Implement	
bu./A.	Av. Bu./A.	bu./A.	Av. Bu./A.	bu./A.	Ave. Bu./A.
19.56	19.97	22.63	21.10	27.13	26.79
20.38		19.56		26.44	

Difference required for significance: 4.23 bu.

Soil and Water Loss from Plots on 3.8% Slope Austin Clay During June 28th Rain of 3.20 Inches - J. R. Johnston, Temple, Texas.-"This storm caused soil and water loss on all erosion plots and terraced areas. The data in Table 1 show the soil and water loss from a number of the plots in the control plot area. These data, as date in the past have shown, clearly show the value of sweetclover as a soil and moisture conserving crop.

Plot No.	1947 Crop	1948 Crop	Runoff Inches	Runoff Percent	Soil Loss T/A
5	cotton	oats	0.542	16.94	0.38
4	cotton	oats(hubam)	.377	11.78	.32
2	cotton	hubam	.227	7.09	.03
7	oats	cotton	1.640	51.25	6.33
8	oats(hubam)	cotton	1.588	49.62	4.27
9	hubam	cotton	.754	17.94	1.19
3	corn	corn	.989	30.91	1.92
6	Bermuda grass	Bermuda grass	.012	.38	T

Grazing Days and Production per Acre from Erosion-Resistant Forage Crops - "Erosion-resistant forage crop evaluation studies have given some interesting steer gain figures. These data are shown in Table 2. The unusually high gains from sudan would not have been possible without the soil improvement obtained with hubam growing on the land in 1946 and 1947. This field of sudan with the aid of the summer rains may produce in the neighborhood of 500 pounds steer gain per acre in 1948.

Crop and Treatment	Grazing Days	Pounds gain/A
Unimproved Bermuda-buffalo pasture	83	87
Improved Bermuda-buffalo pasture	83	102
Native pasture	83	91
Sw. sudan (after 2 yrs. hubam)	44	232
Oats (sweetclover	83	126
Oats (sweetclover) - fertilized	94	209

Relative Response of Oats to Phosphate on Class I, II, and III Land -"Station personnel observed and sampled oats on a Soil Conservation District Cooperator's farm where the grain was grown on 3 classes of Blackland with and without phosphate fertilization (phosphate fertilization at rate of 20 lbs. P_2O_5 per acre). Oat yields without phosphate fertilization were 44.4, 25.1, and 12.1 bushels per acre for land classes I, II, and III respectively. Yields with phosphate were 44.8, 37.4, and 34.2 bushels per acre for land classes I, II, and III respectively. Winter killing of the oats receiving no phosphate on this farm during the March 11 freeze were approximately 5, 60, and 95 percent respectively for land classes I, II, and III. Very little winter killing occurred where the oats were fertilized with 20 lbs. P_2O_5 per acre."

Effect of Post Cutting Schedule on Yield of Kudzu - B. H. Hendrickson, Watkinsville, Georgia.-

Hay harvest, 1944-1947 period		Kudzu hay yields First cutting, June 3, 1948
Number per year	Dates	Tons per acre
Three	June 1, July 15, and October 15	1.36
Two	June 1, July 15	2.23
One	October 15	2.77
One	September 1	1.56

"The heaviest spring hay yield in 1948 was obtained after kudzu had been cut only once a year (October 15) during the previous 4 years. A series of annual cuttings on September 1st in 4 previous years sharply reduced the vigor of the stand. Not over-two early-season cuttings are indicated as most desirable for perennial hay crop purposes."

Effect of Different Land-Preparation Tillage Methods on Wheat in a 3-Year Rotation on Wheat-Sown Kobe Lespedeza, 2nd Year Wheat-Volunteer Lespedeza and Cotton -"Mr. John R. Carreker has computed the 1948 wheat yields obtained from his triplicate field block experiment, and reported them in the following tables.(1 and 2). In tables 3 and 4 are listed the 2nd and 1st year wheat yields by years during the 1944-1948 period.

"Sanford wheat was planted December 5, 1947 and fertilized with 300 lbs. per acre 0-14-10 at planting ≠ 100 lbs. per acre Nitrate of Soda March 19, 1948.

Table 1

Terrace No. 7 - 2nd year wheat after wheat-Kobe.

	Ripper bu./acre.	Disc Harrow bu./acre	Disc Tiller bu./acre	Disc Plow bu./acre
Block A	15.0	11.6	14.4	12.8
Block B	11.0	10.2	12.4	15.8
Block C	17.9	7.4	18.3	17.2
A, B, and C Average	14.6	9.7*	15.0	15.3

* The stand was noticeably thinner on the disc harrow plots.

Table 2

Terrace No. 10 - First year wheat after cotton, all plots disc tilled for wheat after the 4 tools had been used prior to planting cotton.

	Ripper bu./acre	Disc Harrow bu./acre	Disc Tiller bu./acre	Disc Plow bu./acre
Block A	20.2	19.6	18.8	15.4
Block B	20.0	18.0	18.0	23.0
Block C	18.4	21.4	22.6	20.2
A, B, and C Average	19.5	19.7	19.8	19.5

Table 3

Wheat yields by years where the second year wheat followed wheat-lespedeza with 4 methods of land preparation, 1944-1948 period.

Terrace No.	Year	Ripper bu/acre	Disc Harrow bu./acre	Disc tiller bu./acre	Disc Plow bu./acre.
11	1944	25.1	21.8	21.0	29.1
7	1945	11.8	11.0	13.1	13.2
10	1946	17.5	14.2	17.7	24.3
11*	1947	21.6	20.9	23.3	20.9
7**	1948	14.6	9.7	15.0	15.3
5-Year Average		18.1	15.5	18.0	20.6

* Repeated on same land used in 1944.
** Repeated on same land used in 1945.

Table 4

First year wheat yields by years (1944 - 1948 period) where wheat followed cotton in a 3-year rotation where the cotton was planted after 4 methods of land preparation.

Terrace No.	Year	Ripper bu/acre	Disc Harrow bu/acre	Disc Tiller bu/acre	Disc Plow bu/acre
7	1944*	34.0	29.2	40.0	34.4
10	1945	18.7	17.2	21.3	19.3
11	1946	23.6	22.9	22.7	26.0
7	1947	23.9	23.2	24.5	21.6
10	1948	19.5	19.7	19.8	19.5
5-Year Average		23.9	22.4	25.7	24.2
1945-48 4-yr. Average		21.4	20.8	22.1	21.6

* Wheat planted after soybeans. All plots were tilled with the respective tools listed. In all other years the cotton stalk land was turned with the disc tiller across all plots.

Climatic Hazards of Erosion - D. B. Krimgold, Washington, D. C.- "In the April issue an expression was presented for the functional relationship between erosion from a plot or field of given shape, length and degree of slope and given soil cover and moisture conditions. Further study of this subject resulted in an improved expression which describes this relationship more rigorously. The expression is based on the hypothesis that the relationship between soil loss from a plot or a field is a positive exponential function of the power of surface runoff and the power of raindrops, the former being the rate of surface runoff in cfs times the distance through which it falls and the latter the mass (volume or amount in inches) of rain falling on the surface of the soil in a unit of time.

"The terms used in the expression involve the following concept of movement of water into and through soils: When rain falls or snow begins to melt the water enters the soil at some rate f_1, it continues to move into the soil at this rate for a period t_1 at the end of which the rate begins to diminish, in most cases quite rapidly. At the end of a period t_2 following t_1, a constant or nearly constant rate f_2 is reached. In some instances the constant rate f_2 may begin to further diminish at the end of a period t_3 and a lower nearly constant value f_3 may be reached at the end of a period t_4. The values of f_1, f_2, f_3 and of t_1, t_2, t_3, and t_4 vary not only with the permeability of the subsoil and other more or less fixed characteristics of various soils, but also with the state and stability of the structure of the surface soil, the degree of protection by living plants and plant residues, the moisture content of the surface soil, and the available soil moisture capacity of the soil profile at the beginning of the rainfall or snowmelt period. t_1 and t_2 will also vary with rate and drop size of rainfall and the rate of snowmelt.

"When the rate of rainfall or of snowmelt exceeds the rate of movement of water into or through the soil water begins to collect in the depressions on the surface of the soil. These depressions fall in two categories. 'temporary' and 'permanent'. When, on unprotected land, rainfall or snowmelt continues long enough to produce measurable soil loss all or nearly all the temporary depressions are destroyed and drained by rilling. The 'permanent' depressions which are features of the natural relief or such work of men as terraces with closed end or contour furrows remain intact and such water as may accumulate in them eventually enters the soil or evaporates and does not appear as surface runoff. The volume of 'permanent pondage' may be determined directly or indirectly when necessary.

"Assuming that values of t_1, t_2, etc. and of f_1, f_2, etc. for the required range of conditions can be determined experimentally, soil loss (S. L.) from a plot or a field resulting from a continuous period of rainfall or snowmelt can be expressed as follows:

$$S.\ L. = K\left[\frac{P_1 + \overline{P_{1,2}} + P_2 + \overline{P_{2,3}} + P_3 - S}{T}\right]^n$$

Where P_1 is the amount of rainfall occurring during the period t_1 minus $(f_1\ t_1)$, the amount entering the soil during this period

$\overline{P_{1,2}}$ is the amount of rainfall occurring during the period t_2 minus the amount $\left[\frac{f_1 + f_2}{2}\right] t_2$

P_2 is the amount of rainfall occurring during the period t_3 minus the amount $f_2\ t_3$

$\overline{P_{2,3}}$ is the amount of rainfall occurring during the period t_4 minus the amount $\left[\frac{f_2 + f_3}{2}\right] t_4$

P_3 is the amount of rainfall occurring during the period t_5 minus $f_3\ t_5$

S is the volume of permanent pondage.

T is the duration of runoff which is nearly equal to the sum of the time intervals during which the rate of rainfall or snowmelt exceeded the rate of movement of water into or through the soil.

K is a numerical constant, the value of which is determined by the length and degree of slope.

N is a positive number which can be greater or less than one, depending on the resistance of the soil to detachment and transportation.

P_1, $P_{1,2}$, etc. can be amounts of snowmelt as well as of rainfall.

"It has been suggested that this expression could be improved by using the average rate of each amount (P_1, $P_{1,2}$, etc.) separately rather than the average rate for the entire rainfall or snowmelt period. The advisability and possibility of doing so is being investigated and the results will be reported in a subsequent report."

DRAINAGE AND WATER CONTROL DIVISION

Hydrologic Studies - L. L. Harrold, North Appalachian Experimental Watershed, Coshocton, Ohio.-"The month of June was noted for its number of storms of high rainfall rate. Although the total rainfall for the month was slightly over normal, there were five excessive storms. The table on page 15 gives the rainfall rates for 3, 5, 10, and 15 minutes and the corresponding runoff peaks and totals for corn watersheds less than 3 acres in area.

"The most striking fact revealed by these data is the complete control of water and conservation of soil by mulch on watershed 188. Only about two-thirds of the rows are contoured, others are on the slope. Yet there was only a trace of surface runoff and practically no soil loss.

"The flood peaks on the straight-row cornfield for the June 19 and 28 storms were about 90 percent of the rainfall rate. Runoff totals on this watershed for these storms exceeded 50 percent of the rainfall. This is high water loss.

"Contouring was effective in reducing flood peaks and totals as well as slowing up the erosion process. Reduction in flood peaks ranged from a maximum of about 90 percent for the first storm to a minimum of 35 percent for the storm of June 28. Water conservation ranged from 80 percent, (a maximum), to 32 percent, (a minimum)."

Hydrologic Studies - J. A. Allis, Central Great Plains Experimental Watershed, Hastings, Nebraska.-"Rain was recorded on 13 days during the month at the meteorological station with a total catch of 4.25 inches.

"Lack of moisture at seeding time on severely eroded slopes in the corn is quite evident. On these slopes there was insufficient moisture to germinate the seed, hence there is very little corn, while on the less eroded land in the same field there is a good stand of corn.

"On June 26, the largest rain of the month occurred. This rain varied from 1.09 to 1.20 inches in the vicinity of the small watersheds, with about 0.52 inch falling in 15 minutes during the period of maximum intensity.

"The following peak rates of runoff are tabulated for the 4-acre (approximately) small watersheds in various land-use practices. (Page 16.)

Date	Rainfall					Runoff from watershed No. -						Soil loss from watersheds (tons per acre)		
		Maximum rates for -				106 1/		121 2/		188 3/				
	Total	3 min.	5 min.	10 min.	15 min.	Total	Peak	Total	Peak	Total	Peak	106	121	188
June						In.	In/hr	In.	In/hr	In.	In/hr			
12	0.65	2.10	2.04	1.92	1.40	0	0	-0	0	0	.0	0	0	0
19	1.10	4.30	4.00	3.48	2.80	.60	3.90	.12	.46	0	0	4.7	.9	0
24	.78	5.60	5.04	1.38	1.20	.32	1.82	.14	.81	0	0	4.9	1.2	0
27	.29	2.40	2.04	1.44	.96	.08	1.32	.04	.34	0	.0	2.9	2.3	0
28	.63	3.60	3.12	2.46	1.64	.40	2.61	.27	1.51	.003	.01	.8	.7	T
29	.46	5.50	--	--	--	.17	2.89	.10	1.41	0	0	2.2	1.1	0
30	.11	--	--	--	--	.03	.23	.01	.07	0	0	T	T	0
Total for month	4.81	--	--	--	--	1.60	--	.68	--	.003	--	15.5	6.2	T

1/ Plowed corn in straight rows across the slope.

2/ Plowed corn on the contour.

3/ Mulch cornland mostly on contour.

Maximum Rates of Runoff

Straight Row Watershed No.	Straight Row In/hr.	Contoured Watershed No.	Contoured In/hr.	Subtilled Watershed No.	Subtilled In/hr.
		Oats			
3H	0.78	5H	0.26	14H	0.07
16H	.22	13H	.44	21H	0
Ave.	0.55	Ave.	0.35	22H	.02
				Ave.	0.03
		Wheat			
4H	0.64	8H	0.06	11H	0.10
12H	.85	17H	.93	19H	.24
Ave.	0.74	Ave.	0.50	24H	.18
				Ave.	0.17
		Corn			
6H	1.03	7H	0.54	10H	0.37
15H	1.24	9H	.48	20H	1.00
Ave.	1.14	Ave.	0.51	23H	1.22
				Ave.	.86

Note: Oats substituted for wheat 1948.

Hydrologic Studies - R. B. Hickok, Lafayette, Indiana.-"Beginning early in March, the accumulated total rainfall for the year became and continued significantly above the local 'normal' through April and May, and was barely within the probable range of 'normal' through June. Rainfall was recorded during 9 days in April, 14 days in May (all within the first 17 days of the month), and 12 days in June. Rains totaling approximately 3-1/2 inches during April 5, 6, and 7 on the Throckmorton Farm produced substantial runoff from the experimental watersheds, as shown by the following table:

Total runoff losses from approximately
3-1/2 inches of rainfall, April 5-7, 1948,
Experimental watersheds, Purdue-Throckmorton Farm
Lafayette, Indiana

Crop	Treatment	Runoff (inches)
Corn (Residue from 1947 crop)	Prevailing	1.59
	Conservation	1.13
	Difference	0.46
Wheat	Prevailing	2.02
	Conservation	1.23
	Difference	0.79
Meadow	Prevailing	1.67
	Conservation	1.75
	Difference	-0.08
P. Pasture		2.33

"As is generally the case with heavy rainfall in early spring, the watersheds in the permanent pasture and meadow yielded more runoff than those in wheat and in corn stalks. Previous treatment did not significantly affect the runoff from the meadow watersheds. The most substantial effect of treatment was on the wheat watersheds, which were drilled on the contour and, because of higher fertility, had somewhat heavier cover, (latter probably was not a positive factor in reducing the total runoff under the circumstances). The corn stalks from the previous season had been knocked down during the winter, in the direction of the rows, those on the conservation treated watersheds being in the direction of the contours. There was also noticeably greater volume of corn stalk litter on the latter watersheds. Apparently rolling the corn stalks down on the ground afforded substantial runoff protection. This confirms the previous year's observations of this practice.

"Wheat on the prevailing treated watersheds was a very thin stand and not heavily headed. That on the conservation treated watersheds stooled out much more, was taller and had heavier heads than that on the prevailing treated watersheds. In both cases, the stand was poor due to insufficient discing of the ground to cut up the bean straw prior to seeding the wheat, resulting in very poor covering of the seed.

"Hay was mowed on June 24 and 25, and was in the swath about a week through a series of rains. We were unable to make a sample harvest of the hay; but from a count of bales on the watersheds and estimate of their average weight, it is estimated that the prevailing treated watersheds averaged 1.1 T/A, compared to 1.9 T/A for the conservation treated

watersheds. The latter also contained the highest percentage of legumes. Hay, this season, was cut in good time, before maturing of dock and other weeds.

"Mr. Norval L. Stoltenberg took up his duties here on July 2, filling the Soil Scientist position on our project staff in which there has been no active incumbent since May, 1947."

Hydrologic Studies - R. W. Baird, Waco, Texas.-"At rain gage No. 69 rainfall for June totaled 1.38 inches. All the rain of the month fell June 25, 26, and 29. Prior to the rain of June 25 all fields were very dry. At the end of the month there was some moisture in the surface foot of soil but little reserve at greater depths. More rain is badly needed for pastures, corn, sorghum, and cotton. The corn yield has been lowered by the hot, dry windy weather of the first 24 days of June. Many fields of corn in the area have been completely ruined, but a fair crop is probable on most of the Government-owned land. Good progress has been made on harvesting oats this month. All of the oats on the project have been cut and some of the windrowed oats combined. The yield is somewhat better than anticipated since the damage from the severe freeze in March. The fields harvested have yielded about 25 bushels per acre.

"Runoff results from the rains of May and June have been computed and are shown in table 1. It will be noted that except for area W-6, the amount of water retained on the area was appreciably higher on the areas with conservation practices. Area W-6 is an area that has always had an unusually large capacity to take up rainfall except after prolonged wet periods. The native meadow area SW-12 had very little runoff but there was about 3.7 runoff from the area SW-17 where work was started in January 1948, establishing pasture on formerly cultivated land. This was more runoff than from any other area from which measurements have been made. The Bermuda grass on this area is spreading and the runoff conditions should change rapidly.

"With the dry weather of June following these runoff periods of April or May it will be interesting to see if any greater drought resistance and increased yields result from the increased amount of moisture retained on the area.

Table 1.--Months of April and May, 1948

Area	Size in acres	Rainfall	Rainfall-runoff	Treatment
W-1	176	11.012	8.752	Straight rows ordinary farm practices
W-2	130	11.107	8.808	Straight rows ordinary farm practices
W-6	42.3	10.980	9.487	Straight rows ordinary farm practices
W-10	19.7	11.300	8.171	Straight rows ordinary farm practices
Y	309	11.027	9.193	Terraces contour cultivation and improved rotations
Y-2	132	10.980	9.130	Terraces contour cultivation and improved rotations
Y-4	79.9	10.985	9.468	Terraces contour cultivation and improved rotations
Y-6	20.9	10.923	9.293	Terraces contour cultivation and improved rotations
Y-7	40.0	11.146	8.477	Terraces contour cultivation and improved rotations*
Y-10	21.0	11.021	9.315	Terraces contour cultivation and improved rotations
SW-12	2.97	11.140	10.629	Native meadow
SW-17	2.99	10.970	7.294	Cultivated land returned to pasture grasses. Work started in Jan. 1948.

*Rotation not being followed on about 30 acres of privately owned land.

Hydrologic Studies - G. A. Crabb, Jr., East Lansing, Michigan.-- For the month of June precipitation, as measured by the U. S. Weather Bureau type of non-recording rain gages at the project's watersheds, amounted to 3.97 inches at the cultivated watershed, 3.98 inches at the wooded watershed, and 4.03 inches at the stubble-mulch plots. The U. S. Weather Bureau at Lansing reported 3.10 inches of rain, which is 88 percent of the 50-year average of 3.51 inches recorded for this same area. In comparison, precipitation at the project's watersheds represented 113 percent and 115 percent of the 50-year average.

"There was runoff amounting to 0.3394 inch at watershed 'B', but no runoff was recorded at watershed 'A' or the wooded watershed. The major runoff on watershed 'B' occurred on June 28 following a storm of high intensity in a duration of 53 minutes. A rainfall of 0.74 inch caused an accumulated total of 0.3336 inch of runoff. Soil losses have not yet been computed for this runoff.

"On June 8, 9, and 10, the Project Supervisor in company with Mr. C. L. Engberg, Mr. N. P. Dahlstrand, SCS Operations, and Prof. J. F. Davis, Soil Science Department of Michigan Agricultural Experiment Station, made preliminary surveys of muck lands in and adjacent to Livingstone County, Michigan, in connection with the new studies of the subsidence of organic soils, CMI-R-1; (R-2-1-1). An attempt to determine subsidence by comparing present profiles paralleling drainage ditches in muck fields with known cropping practices, against the original construction ditch profile, was found to be impractical.

"Accordingly, it was decided to make such comparative studies only on fields which had been cross-sectioned before drainage, and on new muck fields. It is anticipated that this study will, with a comparatively small investment of time and effort, yield valuable data on some little known phases of organic soil science.

"The pyrheliometric study which has been attempting to compute and construct a normal curve of total solar radiation at East Lansing, by days of the year, has been completed. There has been prepared a tabulation of values of average of total solar radiation (gram-calories per sq. cm.) for each day in the year, a chart showing the location of each of these values and a smooth curve representation of these values, and another chart showing total solar radiation by days for the calendar year 1947 with this normal radiation curve superimposed thereon. This material will be made available to anyone upon request. It is proposed to plot all past data in this manner at an early date, and to keep current data sorted, also, in this manner for ready graphical analysis. It is felt that this normal evaluation of local solar radiation will be of considerable value in studying the effect of solar radiation upon the hydrologic relationship of the soil, and in related fields of farm crops and horticulture as well. There is keen interest being evidenced by Experiment Station personnel in the possibility of solar radiation at the time of fruit-setting affecting the quality of the year's fruit and solar radiation during the growing season affecting the milk-producing quality of dairy feeds. Ample evidence is apparently at hand to justify further inquiry in this matter. Considerable appreciation is felt to Director V. R. Gardner, of the Michigan Agricultural Experiment Station for his keen interest in the horticultural possibilities of analysis of solar radiation data, and his guiding of the project supervisor's thinking in the approach to analysis. The determination of normal pattern of radiation is a fundamental to any program of such analysis, because of the widely fluctuating pattern of day-to-day radiation. It is interesting to note that the normal pattern of radiation presents a type of bimodal curve, apparently consisting of two overlapping phases, each showing an ogive pattern, and having a definite tendency to skew away from the solstices. The junction of the two modes forms a definite plateau during critical months of April and May, whereupon the curve climbs to a peak in the latter part of June, dropping off smoothly with the exception of a period during the latter part of July, and 'Indian Summer', to the 'doldrums' of winter radiation. The peaks of November and December have a definite relationship to the 'presnow' warm spell and the Christmas thaw, which are typical here.

"The method of arriving at the normal curve was relatively simple, but extremely tedious. The tabulated records of total daily solar radiation for the period of 12/42 - 12/47 were assembled, and by trial and error it was determined that a 15-day moving average of the overall data would in large measure smooth the widely varying day-to-day data. So such an average was computed for the total period of the study. Days of each year were then numbered and an arithmetical average was computed for all days having the same number. Leap years were not computed as such. Thus a 5-year average of the 15-day moving average was arrived at, and tabulated. However, even with this much mathematical smoothing, the curve was too irregular for practical purposes, as evidenced by the scattered points plotted with the final curve, and further refinement was deemed advisable. However, there appeared to be no feasible mathematical solution to the curve, so it was smoothed by eye. The resulting curve appears to be eminently satisfactory, with the possible exception of the period of April 25 to May 4, where possibly too much refinement has occurred."

Runoff Studies - N. E. Minshall, Madison, Wisconsin.-"Precipitation at Edwardsville for the month was 4.76 inches or slightly above normal. Of this amount over 4 inches fell in the last 10 days. There was no prolonged period of high intensity and no high rates of runoff. The total runoff amounted to 0.30 inch. Temperatures varied from a maximum of 94° on the 5th to a minimum of 42° on the 1st. The average for the month being 69° or slightly below normal.

"Precipitation at Fennimore for the month was 1.54 inches as compared to a normal of 4 inches. There was no individual daily rainfall total of .25 inch since June 5th. Temperatures were slightly below normal for the month.

"On June 1st and 2nd, I established recording and standard rain gages in the heavy soils area of Central Wisconsin, near Colby. These were established as a preliminary to construction of a runoff measuring station on a 350-acre watershed. At that time I also took soil moisture samples and determined the percentage of moisture of the soil with the Toledo Tester. In general, the ground was very dry and the percent of the moisture in the top 12 inches was: Hay 9 percent; grain 12-15 percent, and corn 20-25 percent. This information on soil moisture has already been of considerable value to the Wisconsin Valley Improvement Company, in convincing their directors that with a normal June rainfall they could expect very little runoff from drainage areas within this section and for this reason the storage reservoirs should not be drawn down drastically at this time. The paper mills in the Wisconsin river valley have revised their method of manufacturing paper by using a different type of wood, which will require only 1600KW per ton of paper instead of 2,400 for the type formerly used."

Drainage Studies - M. H. Gallatin, Homestead, Florida.-"All work in the past done by other men in other sections of the country have shown that cyanamid ($CaCn_2$) to give the best results must be applied only in areas where the organic content of the soil is high. We have recently had the opportunity to do some work on this, as two of our cooperators

applied cyanamid on areas low to moderately low in organic matter. In the one case $CaCn_2$ was applied to a young grove approximately 18 months old. Prior sampling showed that the nitrate nitrogen was low 1-3 ppm for the area between the rows. In three successive samplings since application, there has been no appreciable increase in available nitrogen. In the second case, 1-1/2 pounds of $CaCn_2$ was applied broadcast to a mixed lime and orange grove. This area varies in cover from about 15 percent shade to 45 percent shade in the areas having mature lime and orange trees. The soil material is quite sandy for all of this area and the volunteer growth of grass and weeds fair. This area is divided into four blocks as follows: block 1, nearly all lime trees, poor shade, and very little accumulation on mulch material; block 2, shade conditions and residual mulch material somewhat more; blocks 3 and 4, shade conditions about 45 percent and accumulation of organic material in the surface apparent. Prior sampling of blocks 1 and 2 showed the nitrate level at 5-8 ppm. After a two weeks period we found 12-15 ppm of nitrate nitrogen. While the same application applied to a mature avacado grove with an accumulation of organic residues, the level of nitrate nitrogen had increased from 15-20 ppm to 65-70 ppm of nitrates. The increase on the other blocks in the lime-citrus area, having better shade and more accumulation of organic matter, was from an original of 10-12 ppm to 20-25 ppm. Further work will be necessary but indications are that we have only a partial breakdown of the cyanamid material. This process probably goes to NH_3, which is more than likely lost as there is not enough organic matter present for the absorption and storage. In the near future we hope to run some trials on the new formaldahyde-urea compounds now being put out."

Supplemental Irrigation Studies - J. R. Carreker, Athens, Ga.- "Rainfall during the month was sparse, with a total of 2.22 inches, the normal being 4.10 inches. The maximum rainfall on any day was 0.65 inch on June 18, 0.54 on the 27th, and 0.51 on the 16th.

"Evaporation measurements totaled 7.661 inches for the month, with daily amounts ranging from 0.160 to 0.346 inch.

"The corn was given a 1.0 inch irrigation on June 10, and 2.0 inches were applied to the pasture June 11. The vegetables were irrigated on the dates and according to the various plans as follows:

Basis	Date	Amount
1 inch each week without rain:	June 8	1.0 inch
	" 24	1.0 "
1 inch of irrigation when the evaporation equalled 1 inch:	June 12	1.5 "
	" 24	1.6 "
Furrow irrigated:	June 8	1.2 "
	" 24	1.2 "

"The stand of corn on replicate Plot IV was so poor this plot was useless. Therefore, the corn was plowed under and the plot replanted on June 25, one-half to corn and one-half to grain sorghum.

"W. J. Liddell recomputed the 1947 corn yields by 2 methods in contrast with the original method where the yields were computed on a 100 percent stand basis. The new methods were:

(a) Without correcting for stand.
(b) Correcting for stand by the formula - $CW = \frac{H - 0.3M}{H - M} \times F.W.$

Where CW = corrected weight, H = No. of hills present, M = No. of missing hills and F.W. = field weight.

"The yield measurements resulting from the 3 methods of computation are given in table 1. There was little difference in the results obtained by methods I and III. Method II, where there was no correction for stand, gave a considerable reduction in the yield figures as compared to the others. This was to be expected because there was as little as 50 percent stand on certain individual plots."

Table 1

METHOD I. Perfect Stand Method - on the basis of 100 percent stand - samples taken from plants not adjacent to skips in the same row.

	IRRIGATED			UNIRRIGATED		
	12"	18" Bu/Ac.	24"	12"	18" Bu/Ac.	24"
A	84.7	76.7	66.1	76.4	56.5	55.3
B	112.8	92.8	83.6	80.9	63.7	62.4
C	124.1	95.1	79.5	82.3	70.1	68.5
D	116.6	100.3	82.8	79.8	73.3	65.9
Avg.	109.5	91.2	78.0	79.8	65.9	63.0

METHOD II. Uncorrected Plot Totals

	IRRIGATED			UNIRRIGATED		
	12"	18" Bu/Ac.	24"	12"	18" Bu/Ac.	24"
A	56.7	55.7	54.0	41.4	43.8	47.2
B	80.6	73.9	60.6	58.8	46.5	48.6
C	90.6	71.2	57.4	64.3	58.9	54.6
D	78.0	69.2	55.6	62.5	55.4	50.2
Avg.	76.5	67.5	56.9	56.8	51.2	50.2

METHOD III. Corrected for Stand by Iowa Formula - $CW = \frac{H - .3M}{H - M} \times F.W.$

	IRRIGATED			UNIRRIGATED		
	12"	18" Bu/Ac.	24"	12"	18" Bu/Ac.	24"
A	86.4	76.3	63.7	64.8	57.2	56.2
B	103.9	87.1	76.1	77.6	59.3	57.5
C	120.8	88.8	73.6	83.3	69.[illegible]	63.6
D	109.1	90.7	76.2	80.2	71.0	62.3
Avg.	105.1	93.2	84.9	89.5	64.1	59.9

Note: A, B, C, and D above refer to 4 rates of fertilizer.

IRRIGATION DIVISION

George D. Clyde, Logan, Utah.--Mr. Barrett reports completion of his progress report on "Investigations, Design and Construction of Over-snow Motor Vehicles." This report includes (a) a detailed discussion of some of the physical characteristics of snow affecting flotation and traction, (b) design, proportions, features, and limitations. It includes also 16 figures showing the principles involved in traction and flotation in snow. This report is for in-service use only. The results of the preliminary investigations indicate the following:

"(1) By measuring the energy of weighted disks that were allowed to settle in snow under various conditions of application, it was found that when the depth of snow compaction was plotted against the work done in compaction the curve took the form of a parabola. The constant of the parabola differed only with the lightness of the snow. From this the work of compaction by a snowmobile was estimated and was found to be a significant proportion of the power used.

"(2) Indications from all angles of the investigation made are that when compaction is taking place, at the moment the compacting force is brought to rest the snow compacted under it sets up and will then resist a much greater load before it will give way. This suggests the possibilities of materially decreasing the penetration of a given flotation pressure by the design and loading of the ski or track. A study of all types of over-snow transportation vehicles shows a lack of knowledge of this phenomena.

"(3) Internal friction or shear seem to follow the same characteristic exhibited by snow under compaction. That is, while in movement, shear or internal friction is kinetic and materially less than after the snow has come to rest. This, again is exceedingly important in the design and proportions of the track and track cleats or grousers.

"(4) The energy of compaction causes an upward force on the front of the track or ski that must be taken into account if proper load distribution on these elements is to be obtained. It is believed that this particular force factor upsets the load balance that designers have assumed for their machines and has caused existing machines to operate with poor flotation characteristics under important snow conditions.

"(5) The forces that resist compaction together with the nature of snow resistance under kinetic and static conditions greatly limits the longitudinal cross section of the ski or tracks contact surface on the snow. Most designs of track and ski of existing machines indicate proportions that are contrary to the law governing them and therefore give poor flotation characteristics under some very important snow conditions.

"(6) Though practically no information exists on grouser action and, therefore, its desirable proportions, what information has been developed from these investigations indicate that such action and proportions follow definite laws which can be determined.

"(7) Concentration of loading on the track system of a track-laying-tractor type was discussed principally to point out the fallacy that is of common belief, namely, that the fewer wheels in the track system the more simple and light weight the track system will be. A track sinks to the depth of its greatest flotation pressure. This occurs under the wheels, and with the flexibility of the average track this concentration is greater than the average flotation pressure assumes even with wheels as small and close together as practical usage will allow.

"(8) A rolling track compacts snow more efficiently than a ski, but the difference is not great enough to require a narrow ski in order that compaction may be done mostly by the track. A wide short ski, if this can be designed for balance in loading, would benefit steering more than it would impair the effectiveness of the available power.

"(9) Ski or runner cross-section geometry for the denser snow conditions may be rather simple and yet perform satisfactorily. In deep, light snow conditions, side slipping on turning or on side hill travel requires a more effective ski design than what can be obtained from a well banked plain ski with a center fin. A box form of ski is believed most desirable for taking side thrust and should be combined with these other features if much travel is expected through light snow on side hills. In addition, some protection should be worked out for the soft contact surface of the ski when it hits hard objects.

"(10) Load distribution between runner and track should be such that the runner takes the least possible load that is required for guiding the machine. It is believed that the unit loading on the ski or runner should never be more than the unit loading on the track.

"(11) For a small, light machine, if the width-to-height-of-gravity-center is to be large, the clearance under the belly must be low. This may be met by introducing a stationary belly runner to compact the snow to the clearance depth when the machine sinks too deeply. This does not put a serious tax on the available power for if compaction work follows the parabolic law it will use only one-ninth of the compaction work necessary to compact snow one-third of the depth to which the track sinks.

"(12) There are so many advantages of 'fifth wheel' steering over the automobile type of steering that the former should be used for a half track snowmobile."

J. H. Maughn reports completion of manuscript on Utah Drainage Districts. This manuscript is now being reviewed and edited and will be published by the Utah Agricultural Experiment Station.

A new research project entitled "Management of Related Irrigation and Drainage Enterprises" is being started. The object of this research is to develop a sound basis for the consolidation of irrigation and drainage enterprises receiving water from a common source and having common drainage problems. The Lewiston area in northern Utah is being considered for this study. A study of this kind will be of great value to all irrigated areas.

D. K. Fuhriman, who was in charge of the Utah Cooperative Snow Surveys and the consumptive use of water studies in Utah, has been transferred to Puerto Rico to work on an SCS cooperative research project. He was succeeded by Don R. Mitchell.

Use of Irrigation Water, Upper Colorado River Basin - Harry F. Blaney, Los Angeles, Calif.-"At the request of the Upper Colorado River Basin Compact Commission, a field study of irrigation practices and farm irrigation use was made for areas in Arizona, Colorado, New Mexico, Utah and Wyoming. As the result of this study the preliminary report made on March 15, 1948 has been revised. The revised rates of consumptive use of water are for the irrigation season rather than for the frost-free period. A confidential report on 'Consumptive Use of Water Rates, in the Upper Colorado River Basin' by Harry F. Blaney and Wayne D. Criddle has been submitted for review. Examples of estimates of unit consumptive use rates for agricultural crops during the irrigation season for irrigation projects having a full water supply in the Upper Basin, are shown in the following table.

Use of Irrigation Water, Upper Colorado River Basin

Location of project	Normal rate consumptive use, inches 1/ Alfalfa	Grass, hay and pasture	Grains and beans	Corn and other annuals	Orchard
Chinle, Arizona	28.3	24.2	15.4	20.1	-
Kayenta, Arizona	32.5	-	15.2	20.5	-
Grand Valley, Colo.	32.4	28.6	15.2	20.6	24.0
Montezuma Valley, Colo.	24.5	21.5	14.8	18.9	16.7
Upper San Juan Valley, Colo.	17.8	15.6	-	-	-
Animas River, Colo.	22.9	20.1	14.0	17.1	14.8
Bloomfield-Shiprock, N. M.	32.1	28.4	15.3	20.4	21.9
Price River, Utah	26.7	23.5	15.4	19.9	18.7
Green River, Utah	32.5	28.6	16.2	21.7	23.0
Ashley Valley, Utah	21.8	19.2	14.9	-	-
Pinedale, Wyoming	14.8	13.0	-	-	-
Eden Valley, Wyoming	17.2	15.1	13.4	-	-
Ham's Fork, Wyoming	18.6	16.3	13.2	-	-

1/ Includes irrigation water and precipitation.

Imperial Valley Investigations - Falling Head Permeameter - W. W. Donnan, Los Angeles, Calif.-"Some success has been attained in obtaining checks of the coefficient of permeability of field samples by means of a simple falling head permeameter. The apparatus used in Imperial Valley is modelled after apparatus described in Water Supply Paper 887 of the U. S. Geological Survey. The device used consists of a 2-inch brass soil cylinder connected at the base with a small copper U-tube, to which is attached a graduated glass tube. An auxiliary water-supply cylinder is connected to the U-tube to supply water for saturating the soil. Soil is either packed in the 2-inch brass cylinder or samples are taken in place since the cylinder is demountable. Water is introduced through the supply tube until the sample is saturated and water is discharging over the top rim of the brass cylinder. Then the supply valve is turned off and the rate of water drop in the graduated glass tube is noted. This rate of drop is an indication of the transmissibility of the soil. The sample can be taken in the field and a trial of its permeability coefficient can be made on the running board of the car. As an indicator, this device is proving useful for mapping soils for drainage purposes."

Carl Rohwer, Fort Collins, Colorado.-The report by Carl Rohwer on Seepage Losses from Irrigation Channels was completed by the printer the first week in June. Copies of the report have been sent to all cooperators on the project. This report covers a study of the factors

that cause seepage, the development and testing of various methods of determining seepage and the measurement of the actual seepage from lined and unlined canals, laterals and farm ditches under different flow conditions. Most of the work was done in California, but the measurements on farm ditches were made in Colorado. California Agricultural Experiment Station cooperated with the Division of Irrigation on the work in California and Colorado Agricultural Experiment Station cooperated on the work in Colorado. The report was published by the Colorado Station for the Soil Conservation Service.

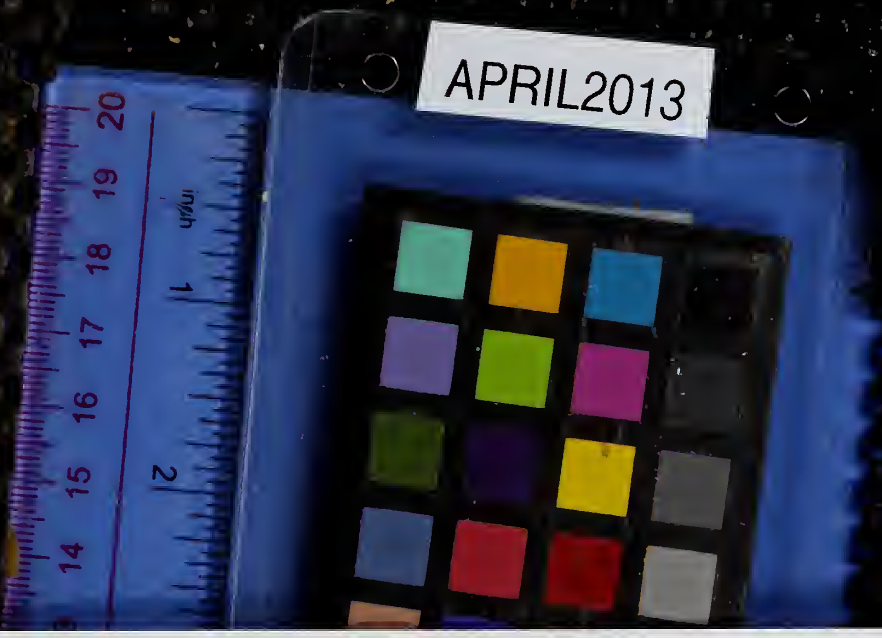
Stephen J. Mech, Prosser, Washington.-"That time, undisturbed repose, and showers, consolidate the loose soil and increase its resistance to erosion was again clearly demonstrated during the pre-planting irrigation of June 14-19. This irrigation run was made about two weeks after the plots were harrowed and ditched. After this ditching the surface 6 inches were loose and detached from the lower soil mass. In the two weeks that intervened between the ditching and irrigation no cultivation of any kind was made. The soil was permitted to remain undisturbed and receive such dews and showers as may occur. A total of 0.91 inch of rain fell as follows: 0.32 inch, 0.46 inch, 0.02 inch, and 0.11 inch on June 10, 11, 14, and 16. Irrigation tests even with large furrow streams produce far less erosion than would normally be expected for freshly cultivated land. To obtain some measure of this accumulated erosion resistance, six plots were reditched one day and irrigated the next.

"As expected, soil losses were increased considerably. Data for comparative soil losses were obtained and will be reported when computations are completed.

"The above test will provide a quantitative measure of the erosion control that can be accomplished by merely changing the time of ditching and irrigation. The usual practice is to ditch today and irrigate tomorrow. A better practice would be to irrigate today and ditch tomorrow (for the next irrigation).

"The more time that will elapse between cultivation or ditching and the actual irrigation the greater is the increase in the soil's erosion resistance.. Time, showers, and even dews all tend to consolidate the loose particles and effect considerable erosion control. This seems like a very simple control measure and should have widespread application."

8/12/48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